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COUNTERVAILING INSTITUTIONAL FORCES THAT SHAPE INTERNATIONALIZATION OF SCIENCE: AN ANALYSIS OF BRAZIL'S SCIENCE WITHOUT BORDERS PROGRAM

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ABSTRACT

This paper theorizes on how globalization and localization affect internationalization of science and analyzes the institutional trajectory of Brazil's large scale program, now suspended, Science without Borders (SwB). Counter to the main goal of SwB, our analysis of the historical genesis of Brazilian science institutions reveals a systemic pull towards localization that dampens internationalization. In addition, our analysis of geographic diversification of grants highlights a missing link in the study abroad value chain, which is a lack of training for global skills. The primary area of concern has been to improve language proficiency. What receives less attention is the development of additional skills, such as a student's ability to adapt to the foreign academic environment, that are critical to cultivation and maintenance of long-term professional and institutional relationships. The missing link of service ought to include improved language proficiency, but go beyond that by working with students to provide the cultural, communication, learning, social, and academic skills that are often assumed in the new foreign environment but are not so evident in the country of origin, such as BrazilKeywords: Internationalization, Institutional environments, Institutional trajectories, Latin America, Brazil, Higher education in STEM

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* Suggested Running Title: SwB and Internationalization of Science.

1. INTRODUCTION

What are the institutional forcers shaping internationalization of science? The importance of understanding the global value chain of higher education in the 21st century is paramount. Governments fund large numbers of international students; universities recruit foreign students, build alliances to enhance their global reach, build offshore campuses with the purpose of reaching foreign markets and expand their global brand name recognition (de Wit, 2002; Scott, 1998; Wilkins & Huisman, 2012). Recent example of governments funding initiatives are President Obama's "100,000 Strong in the Americas" and Brazil's "Science without Borders." With respect to the cross-border movement of students, just in the 2013/2014 academic year there were 886,052 foreign students in the U.S., whereas in 2012/13 there were 289,408 American students abroad (IIE, 2014). From 2008-2012 approximately 85% of international students in the United States attended colleges and universities in 118 metro areas. Over this period the economic impact of these students totaled approximately $34.6 billion with $21.8 billion of that total coming in the form of tuition payments. Higher education represents a major services export (Ruiz, 2014).

Brazil has been consistently underrepresented in terms of the number of students studying abroad. To correct for the specific issue of underrepresentation in STEM (Science, Technology, Engineering, and Math) fields not only in American universities, but ones around the world, and harness the power of STEM as a driver of modern economies, the Brazilian government engaged in an ambitious effort to internationalize science through its Science without Borders (SwB) program, a series of scholarships/grants with the primary goal of giving Brazilian STEM students the opportunity to study abroad. Under increasing economic pressure, the SwB program was suspended indefinitely on September 22, 2015 after sending about 87,000 students abroad at a cost of RS 6.4 billion (approximately $3 billion). Although Brazilian officials shared expectations to reopen it once the economic situation improves (Chade & Vieira, 2015), there are increasing calls for an evaluation of the reach and effectiveness of the internationalization achieved by the SwB (Vieira, 2015).

In terms of the institutional framework that facilitates the internationalization of science, SwB represented governmental support for sending students abroad, while foreign universities were experienced in teaching STEM fields to international students. Even prior to the decision to suspend SwB, questions arose concerning the overall efficacy of the program in terms of the global value chain of (GVC) higher education and the internationalization of science. At the level of the individual student there were numerous cases of the GVC breaking down and the student returning home having failed to reap the desired benefits necessary to justify the cost. At both the individual and institutional level this breakdown undermined the creation, deepening, and durability of relationships that are essential to the long-term efficacy of SwB in terms of promoting the internationalization of science in Brazil. In the absence of more meaningful relationships what remains is purely transactional, based on the host institution's desire to receive international students who pay full-tuition and Brazil's willingness to pay.

Our research explores the effectiveness of SwB and the internationalization of science in Brazil. We review the genesis of the institutional framework supporting the internationalization of science in Brazil and analyze the scope of internationalization achieved by the SwB thus far. We examine what is missing in this global value chain and how it can be improved to produce superior results in terms of improved student performance and more durable institutional relationships. First, we review the literature on institutional forces of globalization, localization and internationalization of services, and we propose an analytical framework to study the internationalization of science. Second, we analyze the institutional framework supporting the SwB program and we analyze its institutional genesis and the scope of its internationalization. We finish with discussion and recommendations.

2. LITERATURE REVIEW

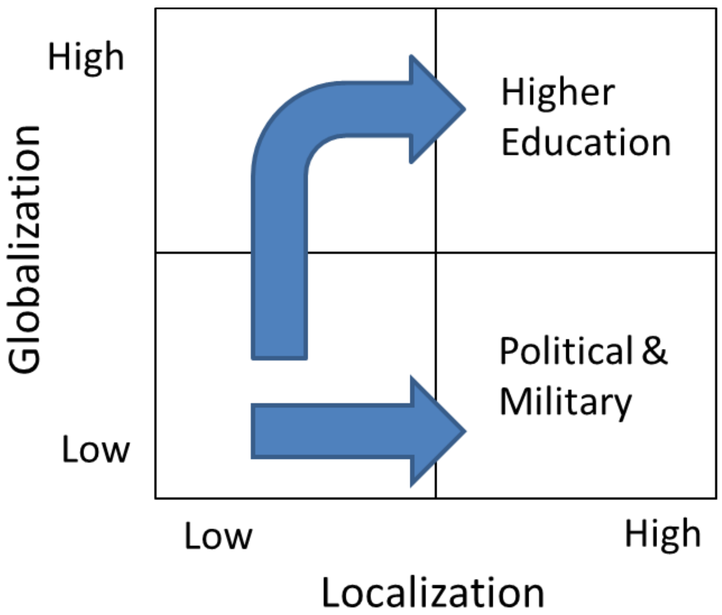
2.1 Institutional trajectories, localization and globalization of science

According to North [1991:97], "institutions are humanly devised constraints that structure political, economic and social interaction, that consist of both informal constraints --sanctions, taboos, customs, traditions, and codes of conduct--, and formal rules --constitutions, laws, and property rights" (North, 1991). Institutional theory sustains that organizational survival depends on conforming to the rules and belief systems prevailing in the institutional environment (Meyer & Rowan, 1977). A drive for legitimacy by conforming to the main institutional logic eventually results in institutional isomorphism, that is, a similarity of patterns of organizational behavior and responses (Dacin, Goodstein & Scott, 2002; DiMaggio & Powell, 1983; Scott, 1995).

We propose that institutional isomorphism plays a fundamental, although seemingly paradoxical, role on the internationalization of higher education in STEM. On one hand, the emergence of a global, knowledge-driven economy has increased the demand for creation and application of new knowledge worldwide (Deepak, 2008), but paradoxically the vast majority of higher education institutions have only pursued small scale mobility of individuals rather than expanding by investing abroad to seek knowledge-creation opportunities in a global community of learners.

This paradox becomes evident when institutions supporting internationalization of science face two countervailing forces, namely, globalization and localization. Globalization is the worldwide integration of countries along political, economic, technological, socio-cultural, and ecological lines. Localization is the process of responding to country-specific political, regulatory and cultural conditions. Localization could also manifest in limited regional integration comprising neighboring countries (e.g., Andean Pact, MERCOSUR) or countries with a common geographic domain (e.g., APEC, EU). Regions are often defined by national agreements, which are crafted to regulate trade among neighboring countries or to reduce the prospect of military conflict.

Figure 1. Institutional trajectories: A Framework to Analyze Internationalization of Sciences



Source: Elaborated by authors

To analyze such paradox we employ a graphical model shown in Figure 1 that represents two systems of beliefs driving internationalization of STEM sciences. One system that requires sharing knowledge and discovery across borders (globalization of knowledge); another that demands keeping knowledge proprietary and country-specific (localization of knowledge). Consider for example the case of internationalization of nuclear science, which is the quintessential science where these forces become evident. On one hand, higher education organizations --ever pursuing the creation of wider communities of learners-- push towards globalization of (nuclear) knowledge. On the other hand, political and military organizations, whose mandate is to keep nuclear weapons and knowledge secret, push towards localization of (nuclear) knowledge to regulate and insulated such knowledge from foreign enemies. The compounding effect of such forces eventually creates the institutional logic that would drive internationalization of science. Thus, our model allows us to track institutional trajectories on two dimensions, globalization and localization.

2.2 Internationalization of services vis-à-vis internationalization of higher education

The process of higher education is a social phenomenon that builds relationships among a community of learners (Strange & Banning, 2001). Learning processes occurring in universities are not unidirectional, but are network/community centered. A central tenet of higher education institutions is to provide services that enable such communities. However, what type of service organizations are they? Erramilli and Rao classified service organizations as either offering *soft services* or *hard services*, where place and time of consumption determine the difference (Erramilli & Rao, 1990). Consumption of a hard service is realized at a time and/or location different that of production, whereas consumption of a soft service occurs simultaneously with production. A hard service could be embedded in a physical good, whose function is to transmit the service. A soft service requires physical proximity between the supplier and the client. Music, architectural design, and engineering services are hard services. Restaurants and lodging are soft services (Ekeledo & Sivakumar, 1998; Grönroos, 1999).

Hard services are easier to export because of the possibility to embed such services into physical goods. Soft services are difficult to export because they are limited by simultaneous production and consumption. Therefore, companies that provide soft services are more likely to use an international entry mode with higher levels of control (Blomstermo, Sharma, & Sallis, 2006; Ekeledo & Sivakumar, 1998), such as wholly owned subsidiaries (highest level of involvement), strategic alliances, or joint ventures. The rise of e-learning through computer mediated communication created opportunities for new types of international programs (Rivas, Snodgrass, & Wescott, 2010). International online programs may range from synchronous online delivery (soft service) to asynchronous online delivery (hard services), or any hybrid forms of delivery in between both extremes. SwB focuses on face-to-face interactions and thus, for the purposes of this paper we treat higher education as a purely soft service.

The typical process of higher education expansion starts with exports/imports and incrementally moving abroad. Universities initially engage in international student or faculty mobility through programs such as Fulbright or via recruiting foreign faculty and students (import-export model). These internationalization efforts are often supported by collaboration with academic institutions abroad (partnerships). Subsequent expansion includes multinational efforts of internationalization of curricula (e.g., ERASMUS), establishing institutional dual-degree cooperation agreements (e.g., ATLANTIS), or mutual recognition agreements. Further expansion would require investment in foreign branch campuses, and implementing transnational university networks (Olds 2007). Most universities use mobility and only a few have invested in branch campuses abroad or established multinational networks (Van Damme, 2001; Wilkins & Huisman, 2012).

A useful paradigm for analyzing incremental internationalization is the Uppsala model, which sustains that operating abroad is difficult and organizations choose to internationalize incrementally owing to a lack of local knowledge –*liability o foreignness*-- (Johanson & Vahlne, 1977; Johanson & Wiedersheim-Paul, 1975). This perspective suggests that higher education institutions first expand to countries that are proximate in psychic (or culture) distance. Simply stated, familiarity with foreign ways would allow a more effective use of existing home-grown knowledge. Having gained experience and capabilities to undertake activities in more culturally distant countries, they would then expand into regions with a higher degree of difficulty. Expansion to psychic/culture distant countries requires higher level of involvement/investment to overcome the corresponding higher liability of foreignness. Therefore, the internationalization of higher education institutions as soft-service requires higher involvement and investment abroad.

Then again the question re-emerges in this new context, why higher education organizations have not pursued the level of expansion and investment abroad that other soft-services organizations have used, like restaurants and lodging, or even like more knowledge intensive soft-services such as accounting or consulting?

Clearly, globalization has a different effect on internationalization when it comes to higher education. De Wit stresses such difference by identifying nine misconceptions of internationalization of higher education (de Wit, 2012), namely:

1. Internationalization is similar to teaching in English [or in other foreign language].
2. Internationalization is similar to studying abroad [e.g., SwB main effort].
3. Internationalization is similar to teaching an international subject.
4. Internationalization means having many international students [e.g., SwB and "100,000 Strong."]
5. Internationalization can be implemented successfully with only a few international students in the classroom.
6. Intercultural and international competencies do not necessarily have to be assessed as such [e.g., SwB lack of instruction and assessment of these competencies].
7. The more agreements an institution has, the more international it is [e.g., SwB main undergraduate focus].
8. Higher education is international by its very nature.
9. Internationalization is an objective in itself [e.g., SwB became an objective in itself].

Note: stress between brackets [ ] added by authors.

In the next sections, we analyze SwB using our model and discuss how globalization and localization affected the emergence of the institutional framework of science in Brazil.

3. SCIENCE WITHOUT BORDERS

3.1 Background

The Science without Borders (SwB) initiative, also known as the Scientific Mobility Program, represents the largest effort by the Brazilian government to raise the profile and capacity of universities and students within the international scientific community. It is the latest attempt to more fully integrate the world's eighth largest economy into the global scientific community. The motivation is explicitly economic. According to President Dilma Rousseff, "We need this type of professional so that science developed in universities and research centers is transformed and rapidly applied, improving our products and services, generating more technology, [and] more wealth for our country."[i] SwB is predicated on the belief that STEM fields are a driver of economic growth and that in order for Brazil to realize its potential it must be a more active participant in the international network. SwB seems analogous to the role of an "export platform" in the global value chain. Brazil sends primary goods abroad, in this case undergraduate and graduate students in STEM fields that are in need of additional training, while importing more expensive secondary goods, researchers who are given financial support to come to Brazil and work temporarily at local institutions. The key difference, however, is that, in sending students abroad, Brazil is not exporting a primary good, but is actually importing a soft service. The face-to-face nature of higher education requires that it be consumed abroad.

3.2 Previous attempts at the internationalization of Brazilian science

SwB is not the first effort to internationalize Brazilian science. Such efforts began in earnest in the 1930's with the founding of the University of São Paulo (USP). From its inception, segments of Brazilian science, particularly the exact sciences such as physics, have looked to internationalization to help create domestic centers of knowledge where engagement with the broader international community would occur as a by-product of the nature of the work, but would not be a necessity in terms of receiving advanced training unavailable in Brazil. USP looked to Europe to find qualified teachers who could be brought in to establish a program and provide not only technical knowledge, but also a connection to the international community. Their ability to attract international physicists such as Gleb Wataghin and Giuseppe Occhialini in the 1930's was greatly aided by the rise of fascism and the desire of many scientists to leave Europe.[ii] Once World War II ended, both Wataghin and

Occhialini promptly returned to Europe and the model focused on visits or short-term stays of notable North American physicists such as David Bohm and Richard Feynman. The most promising students, such as Cesar Latters; Jose Leite Lopes; and Jayme Tiomno, still had to go abroad to receive advanced training. While Science without Borders is unprecedented in terms of scope, its basic objective and approach are as old as STEM training in Brazil.

What should be of concern to those who want to see the country's scientific community more fully integrated into the global value chain of scientific knowledge production is that little has changed over the past 70+ years. The model of the 1930's, 40's and 50's was to be expected given the relative newness of the exact sciences and limited resources. That the need to internationalize science in Brazil persists into the present, hints at the limitations of this approach. The multi-billion dollar question is whether or not the sheer scale of the program will allow it to achieve different results using the same approach. Will SwB produce results that will endure over time in terms advanced research in Brazil and improved institutional relationships abroad? Will universities abroad see Brazil as a true and equal partner or simply as a supplier of students who pay the full tuition? Will SwB move Brazil up the global value chain of scientific knowledge production and application?

3.3 SwB internationalization process

Selection process. For the largest program, the undergraduate year abroad, the first step in the process is a call for proposals by CAPES and CNPq. Brazilian universities then submit their top students based on merit. Finally, the nominated student must prove that they have sufficient language knowledge. The final decision on whether a particular student is a good fit and admissible for a particular institution as a visiting non-degree student is up to that host school. For graduate students looking to complete an entire doctoral program or spend one year abroad there is greater control over the destination as they must be accepted by the host institution abroad prior to applying for a scholarship.

Foreign institutional engagement. Foreign institutions interested hosting students are able to receive additional information through partner institution in Brazil. The potential host institution is required to fill out a participation that enables the Brazilian partner institution to identify appropriate schools interested in hosting candidates. Completing the form does not obligate an institution to participate or accept the candidates.

Student selection of destination university. The institutionalized nature of SwB is exemplified by the fact that most students have no say in the determining which institution abroad will host them. The only way in which they determine their destination is their language capacity. Their Brazilian university in consultation with CAPES and CNPq will submit the application to the host institutions that offer the related field of study (major). The Brazilian institution will determine the most suitable option and present the information. Students may NOT indicate if they prefer specific institutions.

4. ANALYSIS OF SwB INTERNATIONALIZATION

4.1 Institutional trajectory of SwB

SwB is a joint initiative of the Brazilian Ministry of Education and the Ministry of Science, Technology, and Innovation. The governmental support comes from each ministry's funding agency, the Federal Agency for the Support and Evaluation of Graduate Education (CAPES) and the National Council for Scientific and Technological Development (CNPq), respectively. Appendix 1 and Table 1 describe the institutional genesis of SwB. With the exception of higher education and CAPES, all institutions participating in the support and funding of science and technological development in Brazil were oriented towards localization of science rather than globalization.

Table 1: Brazilian institutional genesis according to orientation towards globalization or localization of science

		Globalization		Localization								
Year	**SwB**	**Higher Ed**	**CAPES**	**SBPC**	**CNPq**	**NAEC**	**NCNE**	**FAPESP**	**FUNCTEC**	**BNDE**	**FNDCT**	**Government Planning**
1948				Creation.								
1951			Creation to support 3 areas: scientists in physics, math, and chemistry; experts in finance; and social researchers.									
					Creation motivated by military/civilian applications of nuclear energy.							
1952										Development Bank established in 1952 associated to Ministry of Development, Industry, and Trade.		
1953			Implements PU, 79 scholarships.									
1954			155 scholarships.			Created independent from CNPq.						
1956							NCNE created out of NAEC.					
1960								Created. 1st State-level.				
1964									Created by BNDE to fund grad programs.			
1965		Government established MS ad PhD programs by State Universities.										
1967									FINEP replaces FUNTEC.			PBCT I.
1969											Creation.	
1972					Centralizes Scientific and Tech development funding.							
1976					Change Name, maintains acronym.							PBCT II approved.
1980												PBCT III - decentralizes science to states.
1985												Ministry of Science and Technology created.
1989								Funding increased.				
1995					Mission statement updated.							
2001			Initiate binational university partnership programs for student and faculty exchange.									
2011	Created 7/26/2011 by 1) Ministry of Education and 2) the Ministry of Science, Technology, and Innovation. Administered by CAPES and CNPq.											

Source: Elaborated by authors.
Note: This table highlights the main historic events of institutions created to support science in Brazil. Appendix 1 "Timeline for Institutional Development of Science and Scientific Research Since WWII" describes such historic events as well as each institution in more detail.

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When initially established the four-year program was scheduled to provide up to 97,000 scholarships for undergraduate, graduates, and post-docs in STEM fields to go abroad and 4,000 grants to attract STEM researchers from abroad to work temporarily in Brazil and establish partnerships with local researchers and institutions. Of the 101,000 scholarships, 75,000 were to be financed by the federal government with the remaining 26,000 financed by the private sector. [iii]

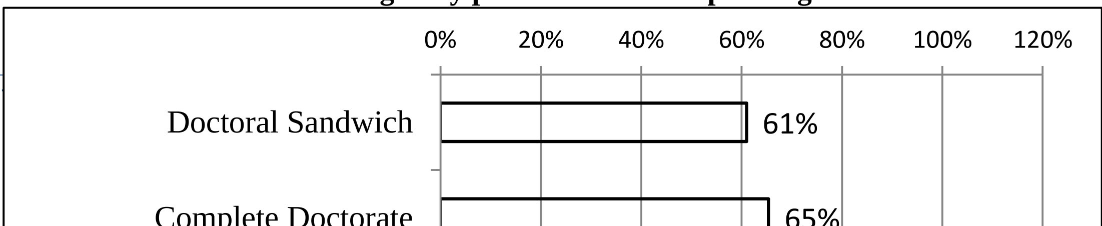
The evidence on modality of the grants suggests that SwB struggled to steer Brazilian scholars into global science communities. For instance, Table 2 shows the various SwB grant categories and compares the number of scholarships and grants originally planned in 2012 versus the number allocated by July 2015. SwB succeeded in sending 5,000 more undergraduate students than planned, whereas SwB fell short by sending/bringing 18,000 less graduates students than planned. In addition, Figure 2 shows that sending undergraduates was extremely successful (108% of planned), whereas binging researchers (36% of planned) and young talent (25% of planned) to Brazil was particularly difficult.

Table 2. Planned versus allocated scholarships and grants by July 2015

Type of Scholarships and grants	Planned 2012	Allocated 2015	Description
Study Abroad			
Doctoral Sandwich	15,000	9,149	Three to twelve month for students currently enrolled in a doctoral course recognized by CAPES. Students improve upon the theoretical/experimental aspects or collect/analyze data for their thesis to be defended in Brazil.
Complete Doctorate	4,500	2,942	Up to four-years to complete a doctoral program abroad.
Post-doctoral	6,440	4,924	One year with the possibility of extending by six or twelve months.
Undergraduate sandwich	64,000	69,042	One year for undergraduates enrolled in STEM fields at Brazilian universities. Student must have completed no less than 20%, but no more than 90%, of their program. Upon finishing, recipients will return to Brazil to complete their degree. Can be extended to 18 months when including language training.
Technological and Innovation Development Abroad	7,060	557	One year of professional training or development for researchers, specialists and technicians. (The addition of scholarships for professional Master's was announced in October 2013).
Bringing Researchers to Brazil			
Special Visiting Researcher	2,000	717	Bring international researchers to Brazil for a minimum of one month/maximum of three months per year for two to three years.
Attraction of Young Talent	2,000	490	Enable accomplished young researchers to spend up to three years in Brazil pursuing research or developing technologies in local universities.
Total	101,000	87,821	

Source: Elaborated by authors.
Data from http://www.cienciasemfronteiras.gov.br/web/csf/painel-de-controle,
Data updated to July 2015.

Figure 2. Number of SwB scholarships and grants allocated by July 2015, as percentage of number of originally planned scholarships and grants in 2012



4.2 Internationalization through SwB

Similarly, the evidence on country of destination suggests that SwB struggled to manage the impact of culture and development differences. Figure 3 shows number of grants plotted on two dimensions — culture and development—that represent how different from Brazil are the countries of destination. This type of mapping is useful to assess the extent of internationalization of SwB.[iv] We calculated the cultural distance between Brazil and country of destination the first FDI as a measurement of psychic distance. This variable has been used in other studies concerning Latin America's internationalization, such as the analysis multinationalization of Latin American multinationals (Cuervo-Cazurra, 2008), or the internationalization of Peruvian restaurants (Rivas & Mayorga, 2011). These authors take the four indicators of work related values developed by Hofstede in 1980—power distance, individualism, uncertainty avoidance, and masculinity—and compute a single indicator of the cultural distance between home country and host country that takes into account the variability of indicators. Unlike these authors, we include also two other Hofstede indicators (Hofstede, 2001)--long term orientation, and indulgence—because these indicators evidently capture important attitudes towards academics.[v] We adapted their formula and sum the square of the differences of the indicators of Brazil and countries of destination divided by the variance of each indicator, and divide this by 6 because we use 6 indicators. We evaluate the development distance between Brazil and country of destination following a similar procedure. We used the three component indexes of the human development index developed by the United Nations—education, health, and income—to create the measure of development distance.[vi] The education index reflects the level of educational achievement in the country using adult literacy rates. The health index measures life expectancy. The economic index identifies standards of living based on gross national income per capita in power purchasing parity terms. To compute the development distance, we use the same formula as for cultural distance.

Figure 3. Map of country of destination by their cultural and development distances regarding to Brazil

Fig. 3 illustrates the country of grantees destination in terms of the cultural and development distances to Brazil. The x-axis measures the development distance. The y-axis represents the cultural distance. Two dominant patterns or strategies are evident. We divide the figure in four quadrants separated at the mean values of the cultural and development distances. The dominant patterns emerge from the number of grantees per country, namely, (a) Grantees that study in proximate countries in both culture and development (23% of total), such as France, Portugal, Italy, Spain, Mexico, Argentine, and Chile among others, and (b) Grantees that study in countries distant in both culture and development (62% of total), such as the United States, United Kingdom, Germany, Australia, South Kore and Japan among others. The secondary patterns, called secondary because of the relatively small number of grantees, are: (c) Grantees studying in countries proximate in culture but distant in development (8% of total), such as Canada and South Africa, and (d) Grantees that study in countries that are distant in culture but proximate in development (7% of total), such as Ireland, Hungary and China.

5. DISCUSSION

In terms of which programs within SwB have resulted in the greatest movement across borders, the undergraduate sandwich program is the unquestioned leader. Given it size relative to the other program, it is not surprising that the largest number of scholarship/grant recipients have come from this category. What is more telling is the number of scholarships/grants allocated as of July 2015 as a percentage of the total number allocated over the course of the program (see Figure 2).The relative ease of sending undergraduates abroad and the challenge of attracting researchers, particularly young talent, to Brazil demonstrates that while there is no shortage of demand when it comes to leaving, there is far less appetite for coming to Brazil, even temporarily, to engage in scientific research or relationship building. This asymmetry reinforces the challenges that Brazil faces in becoming a full member of the global value chain of science go well beyond what is addressed by SwB. Simply put Brazil is not seen by the global STEM community as a meaningful locus of research activity.

What is particularly problematic about the distribution of scholarships/grants is that the undergraduates spending one-year abroad are the least well positioned to develop the networks that are essential to the formation of long-term durable relationships and the integration of Brazil into the global STEM community. Our theoretical framework, as presented in Figure 1, suggests that internationalization of science is achieved when globalization forces and localization forces work to connect scholars into global community of knowledge. Internationalization increases when individuals and institutions establish sustainable networks with global science communities (globalization) and in turn integrate and disseminate knowledge back home (localization). The nature of science is such that many years of training are required to achieve the proficiency necessary to interact productively in global science communities. An undergraduate student that spend one year abroad would have a low chance to establish such long-term professional relationships with leaders from advanced science communities, hence resulting in low internationalization of science. Furthermore, the future path of undergraduates, and thus the potential return on the public investment, is subject to greater uncertainty. On the other hand, doctoral students as well as visiting researchers have a higher chance to establish long-term professional connections that would insert Brazil in knowledge-creating global networks, hence resulting in high internationalization of science. The distribution of grants by modality unambiguously indicates a SwB bias towards undergraduate scholarships as shown in Table 2 and Figure2.

Similar to the distribution by modality, the geographic distribution by country of destination also points towards low efficacy of SwB. The distribution of scholarship and grants by country of destination show another effect of globalization on internationalization, which are the differences of culture and development across countries. SwB did not take into account the dampening effect different culture and development environments have on internationalization. The most predominant strategy was to send students to universities in high culture and high development distance as shown in Figure 3 (62% of total). We observe, as expected, that most of the students were sent to universities in countries with high development distance (70% of total). Such a decision is obviously based on the expectation that STEM expertise is superior in such countries. What is not evident is that most of the grantees were sent to universities in countries with high culture distance (69% of total), without any training on how to navigate such environments.

6. RECOMMENDATIONS

6.1 Beyond SwB

For Brazil to achieve greater insertion into the global value chain of science, the country must go beyond SwB. Giving students the opportunity to study abroad temporarily is but one piece in a much larger puzzle. First, Brazil must make a greater commitment to the domestic institutions that support science research and education. It is not enough for students to spend a year or more abroad only to return to the same institutional challenges. Failure to address these larger issues will result in SwB being little more than just the latest and largest iteration of a decades old strategy that has done little to move Brazil’s position in the GVC of science or higher education. If Brazil does not make a more significant commitment to improving the domestic conditions, there is little reason to believe that partnerships with institutions abroad will have any depth or durability. The relationship between Brazilian institutions and foreign ones will more closely resemble a bilateral trade relationship that is purely transactional and subject to rapid termination, as opposed to a foreign direct investment relationship that is longer-term and predicated upon deeper levels of trust and commitment.

Second, the country must make a greater effort to evaluate the return that they are getting on such a large public investment. One of the challenges in evaluating the efficacy of SwB is the paucity of data. The federal government has invested well over R$6 billion (US$3 billion), but beyond the basic statistics, little data is available in terms of the results produced by SwB.[vii] While it is too early to expect meaningful results, there is currently no system in place for engaging in a long-term longitudinal study on how individual students have benefited from their time abroad in terms the creation of relationships or the development of academic or global skills.[viii] The situation is similar at the institutional level. There is no system to monitor or evaluate the nature or durability of relationships between Brazilian academic institutions and those abroad. The primary engagement is not between Brazilian universities/research centers and similar institutions abroad, but rather between Brazilian governmental agencies, CAPES and CNPq, and universities abroad. As it currently stands one result of SwB may not be durable institutional relationships that help Brazil move up the GVC in STEM fields, but rather international institutions that are more knowledgeable or adept at navigating Brazilian bureaucracy. At this point the only infrastructure designed to maintain relationships emerging from SwB are ones developed by Brazilian alumni of the program so that they might stay in touch with each other. Such an organization, while certainly beneficial to the alumni, is less effective in integrating the country into the global STEM community as it consists entirely of Brazilians networking with other Brazilians.[ix] If Brazil is to achieve the level of insertion into the GVC of science and the economic benefits that come with that, the commitment must be to policies and programs that go beyond merely making for good optics.

Finally, given the economic downturn in the country and the decision to suspend SwB until the financial situation improves, the evaluation of the return on the public investment must take place in conjunction with a reconsideration of the structure and emphasis of SwB. A scaled down, i.e. less costly, version of the program could produce superior results in terms of further inserting Brazil into the global value chain of science and higher education if the focus shifted from undergraduate years abroad to complete doctoral programs and post-docs abroad. Such a refocusing would reduce the total number of students involved, but would increase the levels of engagement and the creation or deepening of more durable relationships.

6.2 Global Skills Development

Upon its resumption, the immediate challenge for SwB is to ensure that students have the commitment and technical, linguistic, and global skills necessary to maximize the benefit of their time abroad. We use the term "global skills" to refer to this set of communication and cultural adaptive skills that go beyond language proficiency and pertain to areas such as academic expectations, acceptable and appropriate behaviors, social expectations, and socialization. In order to take full advantage of their time abroad, and to achieve a greater return on the public investment, students must learn not only academic content, but the communication and cultural adaptive skills. The development of global skills is fundamental to succeed in global communities of science. The lack of such training diminishes the chances to establish long-term relationships with the intended global science communities.

The development of global skills prior to departure would be beneficial to scholarship recipients at every level of SwB and would improve the return on the public investment. If, however, SwB is to resume in its current form with an emphasis on sending undergraduates abroad, then the need for global skills development is particularly important as they can offset some of the previously discussed limitations of undergraduates. Waiting for students to develop such skills while abroad is problematic for two reasons. First, it gives them less time to leverage those skills into a more meaningful and engaging experience and a disproportionately high percentage of the time abroad is spent simply adapting to the new environment. Second, the development of such skills is the goal of the receiving institutions. Even some of the largest universities see such a service as being beyond their core competency. For example, Arizona State University, one of the largest non-profit universities in the United States, outsourced its enrollment counseling for this reason.[x] Among elite universities, especially those that have a strong STEM focus, the core competencies are research and teaching, neither of which helps Brazilian students develop the global skills that are critical to the long term efficacy of SwB.

APPENDIX 1

Timeline for institutional development of scientific research since WWII

1948-- November 8, the SBPC, the Brazilian Society for the Advancement of Science, was created to emphasize the need for institutional apparatuses in the development of science in Brazil.[xi]

1951--January 15, the CNPq (National Research Council) is created "to promote and stimulate the development of scientific and technological investigation in whatever area of knowledge"(dos Santos Albuquerque, 2007). [xii]

CNPq focused on goals similar to SwB:

- Award scholarships for the education and training of researchers.
- Support domestic and international science conferences.
- Support scientific exchange both within the country and abroad.[xiii]

1951--July 11, the precursor to CAPES is created "to ensure the availability of qualified personnel, sufficient in quantity and quality, to meet the needs of public and private projects aimed at the country's development." Particular emphasis was placed on three areas: qualified scientists in physics, math, and chemistry; experts in finance; and social researchers.

1953--CAPES implements the University Program (PU), bringing together the governmental institution with universities and institutes of higher learning. The program also brought in visiting foreign professors, stimulated exchanges and cooperation between universities, and provided scholarships and support for events focused on the natural sciences.[xiv]

1953--CAPES provided 79 scholarships/grants with 54 of those scholarships earmarked for education/training abroad.[xv]

1954--The total number of CAPES scholarships is increased to 155 with 72 earmarked for study abroad.[xvi]

1964--The Technical-Scientific Development Fund (FUNTEC) is created by the National Bank for Economic Development (BNDE) in order to finance the implementation of graduate programs in Brazil.[xvii]

1965--Master's and Doctoral education is institutionalized with the establishment of 38 programs in the Brazil, 27 at the Master's level and 11 at the Doctoral level.

1967--The Strategic Development Program (PED) represents the first time that a formal science and technology policy is adopted. PED enhances the research infrastructure through 1) improving the CNPq and BNDE administered financial support for scientific and technological development, 2) the creation of FNDCT, and 3) the formulation of a basic plan for scientific and technological development (PBDCT).[xviii]

1969--July 31, the government institutes the National Fund for Scientific and Technological Development (FNDCT) in order to finance the expansion and consolidation of the country's science and technology system.[xix]

1972--CNPq becomes the central institution in the National Scientific and Technological Development System. The objective is two-fold, 1) to consolidate programs and projects, and 2) incentivize research in the private sector.

1976--April, PBDCT II is approved by the President.[xx]

1980--PBDCT III is approved. It seeks to 1) decentralize the management of scientific and technological activities with the implementation of State Systems for Science and Technology (SECTs), 2) create the Program for the Support of Scientific and Technological Development (PADCT) with an investment of approximately US$375 million, 3) increase allocation of resources from international agencies such as the Interamerican Development Bank and the World Bank.[xxi]

1995--The CNPq's formal mission statement is updated: "To promote scientific and technological development and to conduct research necessary for the social, economic, and cultural progress of the country."

2001--CAPES initiates binational university partnership programs with the primary objective of increasing the exchange of undergraduate student as well as the exchange of graduate students and professors.[xxii]

REFERENCES

Blomstermo, A., Sharma, D. D., & Sallis, J. (2006). Choice of foreign market entry mode in service firms. *International Marketing Review, 23*(2), 211-229.

Chade, J., & Vieira, V. (2015). Governo suspende abertura de vagas no Ciência sem Fronteiras [Electronic Version]. *O Estado de S. Paulo, 23 Setembro 2015, 03h 00*. Retrieved 9/26/15 from http://educacao.estadao.com.br/noticias/geral,governo-suspende-abertura-de-vagas-no-ciencia-sem-fronteiras-neste-ano,1767249.

Cuervo-Cazurra, A. (2008). The multinationalization of developing country MNEs: The case of multilatinas. *Journal of International Management, 14*(2), 138-154.

de Wit, H. (2002). *Internationalization of Higher Education in the United States of America and Europe: A Historical, Comparative, and Conceptual Analysis*. Westport, CT: Greenwood Press.

de Wit, H. (2012). Globalisation and Internationalisation of Higher Education [introduction to online monograph] [Electronic Version]. *Revista de Universidad y Sociedad del Conocimiento (RUSC). 8*, 241-248. Retrieved 9/21/2015 from <http://rusc.uoc.edu/ojs/index.php/rusc/article/view/v8n2-dewit/v8n2-dewit-eng>.

Deepak, N. (2008). Chapter 1: Globalization: What does it Mean for Higher Education? In E. L. Weber, and Duderstadt (Ed.), *The Globalization of Higher Education* (Vol. Glion colloquium Series No 5). London: Economica.

dos Santos Albuquerque, V. M. (2007). A História do Conselho Nacional de Desenvolvimento Científico e Tecnológico-CNPq. *III Jornada Internacional de Polícas Públicas: QUESTÃO SOCIAL E DESENVOLVIMENTO NO SÉCULO XXI, São Luís - MA, 28 a 30 de agosto 2007*.

Ekeledo, I., & Sivakumar, K. (1998). Foreign market entry mode choice of service firms: A contingency perspective. *Academy of Marketing Science. Journal, 26*(4), 274-292.

Erramilli, M. K., & Rao, C. P. (1990). Choice of Foreign Market Entry Modes by Service Firms: Role of Market Knowledge. *MIR: Management International Review, 30*(2), 135-150.

Grönroos, C. (1999). Internationalization strategies for services. *The Journal of Services Marketing, 13*(4/5), 290-297.

Hofstede, G. H. (2001). *Culture's consequences: comparing values, behaviors, institutions, and organizations across nations* (2nd ed.). Thousand Oaks, Calif.: Sage Publications.

IIE. (2014). Open Doors Report on International Educational Exchange (Publication. Retrieved 9/21/2015, from Institute of International Education, Open Doors Data Portal: <http://www.iie.org/Research-and-Publications/Open-Doors/Data>

Johanson, J., & Vahlne, J.-E. (1977). THE INTERNATIONALIZATION PROCESS OF THE FIRM--A MODEL OF KNOWLEDGE DEVELOPMENT AND INCREASING FOREIGN MARKET COMMITMENTS. *Journal of International Business Studies, 8*(1), 25-34.

Johanson, J., & Wiedersheim-Paul, F. (1975). THE INTERNATIONALIZATION OF THE FIRM -- FOUR SWEDISH CASES. *Journal of Management Studies*, *12*(3), 305-322.

North, D. C. (1991). Institutions. *Journal of Economic Perspectives, 5*(1), 97-112.

Rivas, R. M., & Mayorga, D. (2011). Internationalization of Peruvian cuisine: An analysis of internationalization strategies of Peruvian restaurants. *Innovar*, *21*(39), 205-216.

Rivas, R. M., Snodgrass, C., & Wescott, J. (2010). A Comparison of E-learning with Traditional Models of International Education in Small and Medium Private Colleges. *The BRC Academy Journal of Education, 1*(1), 72-85.

Ruiz, N. G. (2014). The Geography of Foreign Students in U.S. Higher Education: Origins and Destinations [Electronic Version]. *Brookings Institute*. Retrieved 9/23/15 from http://www.brookings.edu/research/interactives/2014/geography-of-foreign-students#/M10420.

Schwartzman, S. (1991). *A Space for Science: The Development of the Scientific Community in Brazil*. University Park, PA: Pennsylvania State University Press.

Scott, P. (1998). *The Globalization of Higher Education*: Society for Research into Higher Education.

Strange, C. C., & Banning, J. H. (2001). *Education by Design: Creating Campus Learning Environments That Work. The Jossey-Bass Higher and Adult Education Series*: ERIC.

Van Damme, D. (2001). Quality Issues in the Internationalisation of Higher Education. *Higher Education, 41*, 415-441.

Vieira, V. (2015). Entidades cobram avaliação do Ciência sem Fronteiras [Electronic Version]. *O Estado de S. Paulo, 26 Setembro 2015, 08h 00*. Retrieved 9/26/2015 from http://educacao.estadao.com.br/noticias/geral,entidades-e-especialistas-cobram-avaliacao-de-resultados-do-ciencia-sem-fronteiras,1768639.

Wilkins, S., & Huisman, J. (2012). The international branch campus as transnational strategy in higher education. *Higher Education, 64*(5), 627-645.

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ENDNOTES

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[i]http://g1.globo.com/educacao/noticia/2013/12/ciencia-sem-fronteiras-passa-oferecer-bolsas-para-mestrado.html

[ii] For more on internationalization and the Brazilian scientific community in the early years see (Schwartzman, 1991).

[iii] The fields that are a part of the program include: 1) Engineering and other technological fields, 2) Exact and Earth Sciences, 3) Biology, Biomedical and Health Sciences, 4) Computer and Information Technology, 5) Aerospace Technology, 6) Pharmaceuticals, 7) Sustainable Agricultural Production, 8) Oil, Gas and Coal, 9) Renewable Energy, 10) Mineral Technology, 11) Biotechnology, 12) Nanotechnology and New Materials, 13) Technology for the Prevention and Mitigation of Natural Disasters, 14) Biodiversity and Bioprospecting, 15) Marine Sciences, 16) Creative Industry (focused on products and processes for technological development and innovation), 17) New Constructive Engineering Technologies, 18) Training of technologists. http://www.cienciasemfronteiras.gov.br/web/csf/metas

[iv] We use total grantees up to July 2015 from http://www.cienciasemfronteiras.gov.br/web/csf/painel-de-controle.

[v] Power distance refers to the acceptance of an unequal distribution of power. Individualism reflects the lack of integration of the individual into groups. Masculinity refers to the assertiveness and competitiveness of individuals. Uncertainty avoidance deals with the level of acceptance of ambiguity and uncertainty. Long term orientation stands orientation towards future rewards, in particular perseverance and thrift. Indulgence refers to the extent to which people try to control their desires and impulses, based on the way they were raised. Relatively weak control is called “Indulgence” and relatively strong control is called “Restraint”. See Hofstede (2001) for a more detailed discussion of each indicator and http://geert-hofstede.com/countries.html for scores.

[vi] We use HDI data for 2013 from http://hdr.undp.org/en/data

[vii] https://www.insidehighered.com/blogs/world-view/brazils-science-without-borders-program

[viii] “Debatedores Apoiam Ciêcias sem Fronteiras, mas Cobram Avaliação do Programa,” August 25, 2015.

http://www12.senado.gov.br/noticias/materias/2015/08/25/debatedores-apoiam-ciencias-sem-fronteiras-mas-cobram-avaliacao-do-programa

[ix] http://www.redecsf.org/

[x] Amanda Ripley, “The Upwardly Mobile Barista,” *The Atlantic Monthly*, May 2015.

[xi] Cadernos SBPC 7 “Fundação e Primeiros Movimentos 1948-1958.” http://www.sbpcnet.org.br/site/publicacoes/outras-publicacoes/caderno_digital/caderno_7.pdf

[xii] http://www.cnpq.br/web/guest/questao-nuclear

[xiii] http://www.cnpq.br/web/guest/anos-50

[xiv] http://www.capes.gov.br/historia-e-missao

[xv] *Ibid.*

[xvi] *Ibid.*

[xvii] http://www.cgu.unicamp.br/ctinfra/finep.html

[xviii] http://www.cnpq.br/web/guest/anos-60

[xix] *Ibid.*

[xx] *Ibid.*

[xxi] http://www.cnpq.br/web/guest/anos-80

[xxii] http://www.capes.gov.br/cooperacao-internacional